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Summary of doctoral thesis

Title:

Outsourcing of services vs. the productivity of enterprises

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The subject matter of the submitted doctoral dissertation was to establish the relationship between the outsourcing of services, in particular business services¹, and the productivity of enterprises in Poland. Longstanding observations of the services sector based on data collected within the surveys of official statistics in Poland suggest that the contribution of this sector to the national economy has been continuously growing, and business services are a particularly, dynamically developing segment of this market.

Reasons for the outstanding development of the services sector, including in particular business services, have been discussed on the international forum for decades. Growing demand for services raised by business entities, often referred to as the outsourcing of services phenomenon, might be one of the reasons. What motivates the enterprises to take a decision to outsource services? One of the most frequent reasons is the desire to improve the efficiency of operating activity. From the economic point of view it is related with the increase in the productivity of factors (measured i.e. by the total factor productivity (TFP)). The use of resources offered by other entities by entrusting them with some tasks and allocating its own resources in the areas where the given entity has a competitive edge gives such an opportunity.

Even though research papers dedicated to that subject can be found in the literature, in Poland this research area has not been undertaken so far due to an information gap in the data. The presence of this gap is an important premise for undertaking the selected research problem. Access to a unique set of data gathered from the resources of official statistics and the knowledge of methodology and organization of surveys enabled to conduct such a study within this doctoral dissertation.

Associated literature

The literature on the subject provides knowledge on the solutions used so far to measure the impact of services outsourcing or other economic phenomena on the productivity of enterprises. The variables reflecting the phenomenon of services outsourcing or the productivity of enterprises, as well as methods for estimating the total factor productivity (TFP) and quantifying the relations between the analysed variables, were selected based on information contained in the studies devoted to the discussed topic.

In the vast majority of research works, the binary variables were used in order to reflect the outsourcing of services². These variables indicate the fact whether the given enterprise outsources the services to satisfy the demand for services, or not. In a study by Girma and Görg (2004) the ratio of the value of external services to the cost of remuneration was adopted as measure for the intensity of services outsourcing. On the other hand, in a study by Schmidt-Ehmcke (2010), outsourcing of services was measured as the costs of external contract works, whereas Gradzewicz and Mućk (2019) in their consideration concerning the impact of globalization on the monopolistic marks-up of Polish enterprises, use the share of the value of external services in the intermediate consumption.

¹ For the needs of this doctoral dissertation business services comprise of: IT services, legal and accounting services, management services, architectural and engineering services, technical testing and analyses services, advertising and market research services, other professional, scientific and technical services, employment services, travel agency, tour operator and other reservation services and related services, security and investigation services, services to buildings and landscape, office administrative, office support and other business support services, services related with education and health care.

² Olsen (2006), Farines and Martin-Marcos (2008), Schmidt-Ehmcke (2010), Mohlmann and Groot (2013).

Total factor productivity (TFP) was most often selected as the variable reflecting the productivity of enterprises (Pavcnik (2000), Smarzynska-Javorcik (2002), Girma and Görg (2004), Farinas and Martin-Marcos (2008), Schmidt-Ehmcke (2010), Mohlmann and Groot (2013), Kinkel et al. (2016), Gradzewicz and Mućk (2019)). Sometimes a simpler measure was used, i.e. labor productivity measured by gross value added per employee (Girma and Görg (2004), Görg and Hanley (2005), Mohlmann and Groot (2013)). Taking into account the results of already completed works, the availability of data and the need for the most precise representation of the analysed concepts, it was assumed that in the submitted doctoral dissertation the share of the value of purchased external services or all purchased services in total in operating costs should be the variable used as a proxy for the outsourcing of services, while the productivity of enterprises should be represented by the total factor productivity (TFP).

The procedures for identifying the impact of services outsourcing or other economic phenomena on the TFP were usually carried out in two stages. In the first stage, the labor productivity or the TFP was estimated at the level of unit data in order to use the obtained results as a dependent variable in the second stage to determine the analysed relationships. For example, Pavcnik (2000) first estimates the Cobb-Douglas production function using the method developed by Olley and Pakes, and then analyses the impact of a country's trade policy on changes in the TFP, using the difference in differences (DID). Instead, to quantify the effects of trade liberalization on the TFP a linear regression model is applied. In turn, Girma and Görg (2004) estimated the TFP based on the Cobb-Douglas production function using the Generalized Least Squares (GLS) method. In order to establish the relationship between the intensity of services outsourcing and the TFP or labor productivity, they used the Ordinary Least Squares (OLS) method. A similar approach can be found in the study of Görg and Hanley (2005), in which the relationship between the intensity of international outsourcing and labor productivity is analysed. They employed the regression models based on the least squares method, as well as the method of instrumental variables. In turn, Mohlmann and Groot (2013), in the first stage, measured the TFP at the enterprise level based on the Cobb-Douglas production function using the method developed by Levinsohn and Petrin. In the second stage of the analyses, they used linear regression models, in particular panel data models with fixed effects (FE).

In the literature, the various forms of the production function are indicated, as well as the methods which enable estimation of the parameters of these functions, and thus also the TFP. The starting point for the analyses is the classic least squares method. The use of this method depends on the assumption that the amount of capital input k_{it} or the labour input l_{it} are independent of other explanatory variables in a model, including the unobservable productivity that is part of the error term ε_{it} . Meanwhile, when determining the amount of inputs, enterprises take into account the factor productivity observed by them, which is not identified by econometricians but included in the error term. Proposals for solving the problem of endogeneity comprised the use of: panel data models with fixed effects (Hoch (1955, 1962), Mundlak (1961, 1963), Mundlak and Hoch (1965)), or the first order derivative of the demand function in relation to the prices of intermediate consumption or producer prices of finished goods (Klein (1953), Solow (1957), Nerlove (1963), Griliches (1971), Hall (1988)), or the introduction of instrumental variables (Griliches and Mairesse, 1998). Subsequent methods consisted of the use of control functions – in particular the methods developed by Olley and Pakes (1966), Blundell and Bond (1999), Levinsohn and Petrin (2003), Wooldridge (2009) or Akerberg, Caves and Frazer (2015), which are employed in the contemporary literature.

Olley and Pakes (1996) or Levinsohn and Petrin (2004) presented the semi-parametric methods for estimating the parameters of the production function. In these methods the error term of the Cobb-Douglas production function is divided into the proper error term and (unobserved by the econometrician) the total factor productivity (TFP). The procedure takes place in two stages.

In the first step, using the classical method of least squares, the parameter for labor inputs is identified, while the aim of the second step is to obtain the parameter for capital inputs, using the unconditional demand function for variables taken as a proxy for the total factor productivity.

The approaches developed by Olley and Pakes, or Levinsohn and Petrin, differ mainly in the variable used as a proxy for the TFP. Olley and Pakes apply investments, while Levinsohn and Petrin use intermediate consumption. The main motivation for using intermediate consumption instead of investments was the fact that most enterprises usually do not record capital expenditure on fixed assets in the reporting year. When the logarithmic form of the production function is used, it makes it impossible to estimate the TFP for enterprises with the non-positive values of investments. Meanwhile, the intermediate consumption is an inherent element of production and zero values for this variable occur sporadically. It potentially makes it possible to obtain the TFP estimates for a larger part of the enterprises' population. In their approach, Levinsohn and Petrin assume, *inter alia*, that enterprises are able to adapt the amount of certain inputs to changes in their productivity flexibly and cost-free. This assumption, however, was subject to criticism, as in fact labor inputs are not independent of the variables applied as a proxy for the total factor productivity.

Therefore, Akerberg, Caves, and Frazer (2015) propose an alternative approach to the TFP estimation, which is based on the method developed by Levinsohn and Petrin. The starting point is the Cobb-Douglas production function, in which the production is reflected by the gross value added. However, in order to control the unobservable productivity, a conditional rather than an unconditional (as in the case of Olley and Pakes, or Levinsohn and Petrin's methods) function of demand for variables being a proxy for the TFP is used. The estimation procedure is conducted in two-stages. In the first stage, no coefficients for the independent variables are estimated, but the non-transmitted error ε_{it} is eliminated. This step uses the least squares method. The coefficients for the input variables are estimated in the second stage using the generalized method of moments. The Generalized Moment Method (GMM) was also applied to estimate the production function by Wooldridge (2009). He proposed to solve the problems identified in the Levinsohn and Petrin or Olley and Pakes procedure by replacing the two-step production function estimation procedure with a single-step procedure.

The method developed by Akerberg, Caves and Frazer was applied, among others by De Loecker and Warzynski (2012) to estimate the TFP when they tried to determine the size of the marks-up. In this case, however, the translogarithmic production function was adopted as a starting point. A similar procedure of the estimation of the production function was also used by Gradzewicz and Mućk (2019) in a study devoted to the analyses of marks-up in the Polish economy. And this solution has been applied in the submitted doctoral dissertation.

To sum up, in the last two decades, there has been a significant development of methods that allow to obtain coherent, consistent and effective estimates of the parameters of the production function, and, as a result, also the value of the total factor productivity (TFP) at the level of individual data. Many studies also undertake the topic of estimating the impact of selected economic phenomena, such as (variously defined) outsourcing of services, on the total factor productivity (TFP). On the other hand, in the literature there is a lack of detailed analyses which would be devoted to establishing the relations between the outsourcing of services and the productivity of companies in Poland.

Objective of work and research hypotheses

The main purpose of this dissertation was to establish the relationship between the outsourcing of services and the productivity of enterprises in Poland, measured by the total factor productivity (TFP).

The main purpose of the work was achieved by the implementation of the following specific objectives:

- 1) Estimation of the total factor productivity (TFP) at an enterprise level, taking into account the data available in the official statistics.
- 2) Determining the relationship between the purchases of external services in total and the total factor productivity (TFP), taking into account the type of business activity and the size of enterprises measured by the number of employed persons.
- 3) Identification of relations between the purchase of total services, including business services, and the total factor productivity (TFP), taking into account the type of purchased services (key services / auxiliary services) and the location of service providers (domestic / foreign).

The starting point for the consideration undertaken as a part of the dissertation was the formulation of the following main research hypothesis:

Outsourcing of services contributes to the increase in the effectiveness of the functioning of enterprises up to a varying degree, depending on the size of these enterprises and the type of services purchased.

This hypothesis results from the theoretical findings in the related literature, which can be summarized as follows: "The main goal of outsourcing is to improve the functioning of the organization. Thanks to the concentration of the organization on its core activity, the effectiveness of its activities should increase and a competitive advantage should be gained." (M. Source-Loda, 2015, p. 395). The use of services outsourcing should therefore boost the operational efficiency of enterprises, which, for the purposes of this doctoral dissertation, is measured as the total factor productivity (TFP).

Taking into account the main research hypothesis, the following specific hypotheses were formulated:

- 1) The higher the share of the total value of services purchased from external enterprises in the enterprise's operating costs, the higher - *ceteris paribus* - the level of the total factor productivity (TFP).
- 2) With an increase in the share of the value of purchased external services in total operating costs, the total factor productivity (TFP) grows relatively more among small enterprises, specializing in a small number of activities, than among larger enterprises with more diversified activities.
- 3) With an increase in the share of the value of auxiliary services purchased from other enterprises in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of the value of key services purchased from other enterprises.
- 4) With an increase in the share of the total value of services purchased from enterprises located abroad in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of total services purchased from enterprises located in the country.
- 5) With an increase in the share of the value of purchased business services in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of the value of purchased external services in total.

Research procedure and methods used

The research work was carried out in two stages. The first stage was devoted to achieving the first of the specific research objectives - the estimation of the total factor productivity (TFP). The aim of the second stage was to establish the relationships between the obtained TFP estimates and the volume of purchased services, thus implementing the second and third specific objectives of the work.

As part of the work, no separate study was conducted, which would collect data directly from enterprises. On the other hand, a unique set of unit data³, which is not available outside official statistics institutions, was used. Data are collected as part of the *Annual survey of business activity of enterprise* (survey symbol according to PBSSP⁴ - 1.61.05) and the *Demand for services survey* (survey symbol according to PBSSP - 1.49.10). In addition, the aggregated data obtained in the following surveys of official statistics were used in the conducted analyses:

- *The structure of consumption of materials, energy, and external services, as well as the material stocks* (symbol of survey by PBSSP 1.44.15),
- *The survey of producer price for services* (symbol of survey by PBSSP 1.64.16),
- *The survey of prices for consumer goods and services* (symbol of survey by PBSSP 1.64.07).

The coverage of the research work was varied. In the first stage, a data panel was used, developed on the basis of information collected for the years 2010-2015 (with 391,335 records for 108,050 units) as part of the *Annual survey of economic activity of enterprises* on the SP form *Annual survey of the enterprise*⁵. It covered legal units with the number of persons being employed 10 and more which run activities classified according to the Polish Classification of Activities (PKD) to:

- Sekcji C *Manufacturing*
- Sekcji D *Electricity, gas, steam, and air conditioning supply*
- Sekcji E *Water supply; sewerage, waste management and remediation activities*
- Section F *Construction*
- Section G *Wholesale and retail trade; repair of motor vehicles and motorcycles*
- Section H *Transportation and storage*
- Section I *Accommodation and food service activities*
- Section J *Information and communication*
- Section L *Real estate activities*
- Section M *Professional, scientific and technical activities*
- Section N *Administrative and support service activities*

Other services sections covered by the *Polish Classification of Activity* (PKD), including Section K *Financial and insurance activities*, were not comprised by the scope of analyses due to the not-fully market type of activity or the limited data accessibility.

In the second stage, however, two panels were used. The first one covered the units from the first stage for which the TFP had been estimated (so-called panel A with 286,751 observations for 70,780

³ The access to individual data was possible due to the fact that the undertaken research works was conducted within the metodological works of the *Polish Official Statistics*.

⁴ PBSSP – Program of Statistical Surveys of Official Statistics introduced on the yearly basis by the regulation of Council of Ministries.

⁵ The draft of questionnaire available at: <http://form.stat.gov.pl/formularze/2016/passive/SP.pdf>.

units). Comparing to panel A, the second panel constituted the sub-population of panel A (so-called panel B with 27,761 records for 18,657 entities) for entities that simultaneously provided data in the *PU Report on the purchase of services* for 2010 or 2015⁶. Panel B was limited to the enterprises with the number of persons employed 50 and more, which run the above-mentioned activities, apart from activities classified to Section D *Production and supply of electricity, gas, steam, hot water and air for air conditioning systems* and Section E *Water supply; sewerage, waste management and remediation*.

In the first stage of research work, the total factor productivity (TFP) was estimated at the enterprise level. Taking into account the most commonly used forms of the production function and the methods of their estimation, the TFP was first estimated on the basis of the Cobb-Douglas production function, using the method developed by Levinsohn and Petrin, and then based on the translogarithmic production function, using the method developed by Akerberg, Caves and Frazer. However, finally, in the second stage of the research work, TFP values estimated on the basis of the translogarithmic form of the production function were used, as it allowed for a better fit of the model to the data. The advantage of the translogarithmic production function over the Cobb-Douglas production function is indicated both by the values of the Student's t-statistics obtained for the squares of the independent variables and for the variable reflecting interactions between variables, as well as by the results of Wald's test which verifies the significance of these variables in model. At the same time, this method made it possible to estimate the TFP at the enterprise level for all surveyed activities within one econometric model. This approach makes it easier to compare the results of the TFP estimates between different sectors of economic activity.

In the second stage of work, an attempt was made to determine the relationship between the share of external services or the total value of purchased services⁷ or their various categories in operating costs and the TFP. For this purpose, panel data models with fixed effects (FE) and generalized additive models (GAM) were used. In addition to the variables reflecting various aspects of services outsourcing, the models also include control independent variables such as: the share of remuneration costs in operating costs, the share of export revenues in the total sales revenues, or binary variables reflecting the size class of enterprises measured by the number of employed persons, or the fact of conducting the economic activity at the level of PKD sections.

In order to achieve the second of the specific research objectives, the data collected in panel A was used. As the key independent variable, the share of the total external services in operating costs (both in a linear and quadratic form) was introduced into the panel data model with fixed effects. In addition, for the purpose of establishing non-linear relations, a semi-parametric panel data model was used, i.e. a generalized additive model (GAM). In this model the key independent variable is introduced in a non-parametric form. In the GAM model, the coefficients for the control independent variables are estimated, as well as the fitted net values of the $\ln TFP$ which are the part of the $\ln TFP$ value that was not explained by the parametric part of the model. This procedure uses a non-parametric estimator based on the Epanechnikov kernel function. On the basis of the fitted net values of the $\ln TFP$ obtained at the enterprise level, plots of the fitted quadratic function and the locally polynomial spline function were created, which enabled presentation of the results graphically. In order to determine the relationship between the share of external services in operating costs and the TFP regarding the type of business activity or the size of the enterprise,

⁶ Data collected cyclically (every 5 years).

⁷ It comprises, apart from the value of services recorded as the external services, also the value of purchased services which are recorded in other fields of costs in the profit and loss account, i.e. remuneration, taxes etc.

a similar procedure was carried out for panel A at the level of the PKD sections and for the subpopulations of this panel separated by the size classes of enterprises.

The third specific objective of research was achieved by estimating models based on the data collected in panel B. In the analyses, in addition to the share of the value of services in the total purchased by enterprises, the variables reflecting various categories of services, i.e. the share of the value of purchased business services, auxiliary or key services purchased from other enterprises, or the value of services purchased from other enterprises located in the country or abroad in operating costs, were introduced. Panel data models with fixed effects were used to determine the relationship between the purchases of the above categories of services and the TFP. In the case of the share of the total value of purchased services in operating costs, an estimation of the generalized additive model (GAM) was additionally performed in order to determine the potential non-linear relationships.

Results obtained

As a result of the conducted research works, its main purpose was achieved, i.e. the relationship between the outsourcing of services and the productivity of enterprises in Poland, was established. Achieving the objectives set in this doctoral dissertation allowed the following verification of the specific hypotheses adopted during the doctoral dissertation:

- 1) *The higher the share of the total value of services purchased from external enterprises in the company's operating costs, the higher - ceteris paribus - the level of the total factor productivity (TFP).*

The coefficients estimated for the variables reflecting the outsourcing of services in the panel A models suggest that the relationship between the share of external services in operating costs and the TFP is generally negative. The results obtained in the panel data model with fixed effects, in which the share of external services in operating costs was introduced in a linear form, indicate that an increase in this share by 1 p.p. is associated with a decrease in the TFP on average by of 0.3%, *ceteris paribus*. At the same time, it was found that with an increase in the share of external services in the operating costs, the TFP decreases up to a certain minimum and after that threshold is exceeded, the TFP is expected to increase. At the same time, the results of the analyses carried out on the basis of the fitted quadratic function indicate that in the case of the share of external services in operating costs, the minimum of function is obtained with a share of 45.3%, and a positive correlation applies to only 8.9% of observations in panel A. For panel B, the results of estimates obtained in the panel data model with fixed effects determined for the share of the value of purchased services in operating costs, turned out to be statistically insignificant for the TFP.

Therefore, the hypothesis in its original form was rejected. However, the statement turned out to be true:

Along with an increase in the share of the value of external services in the operating costs, the total factor productivity (TFP) decreases up to a minimum with the share of services at a level of about 45%. Above this share, the relationship becomes positive.

- 2) *With an increase in the share of the value of purchased external services in total operating costs, the total factor productivity (TFP) grows relatively more among small enterprises, specializing in a small number of activities, than among larger enterprises with more diversified activities.*

Estimates of the coefficients for binary variables determining the size of enterprises indicate that enterprises with the number of employed persons 50 and more are more productive compared to smaller entities. At the same time, the results of estimates of panel data models with fixed effects

carried out for the subpopulations of panel A distinguished according to the size class of enterprises suggest that, similarly to the panel A in total, with the increase in the share of purchased services in operating costs, the TFP decreases up to a certain minimum, and then this relationship becomes positive. However, on the basis of the fitted quadratic function, it was found that a positive relationship between the share of external services in the operating costs and the TFP applies to a relatively larger percentage of smaller entities (i.e. those with 10 to 49 employees) than in the case of enterprises with more employed persons.

Therefore, in the light of the obtained results, the research hypothesis was rejected. The following statement is true:

For each of the considered size classes of enterprises, along with an increase in the share of the value of external services in the operating costs, the total factor productivity (TFP) decreases up to a minimum. A positive correlation between the share of external services in operating costs and the total factor productivity (TFP), which appears after exceeding this minimum, concerns a greater percentage of small enterprises, specializing in a small number of activities, than larger enterprises with more diversified activities.

- 3) *With an increase in the share of the value of auxiliary services purchased from other enterprises in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of the value of key services purchased from other enterprises.*

The results of the estimation of panel data models carried out for panel B, in which the share of the value of auxiliary services and key services purchased from other enterprises in operating costs were introduced as the key independent variables, suggest that these variables are not statistically significant for the analysed phenomenon at the level of 5% significance.

Thus, it follows that the original research hypothesis has not been confirmed. However, the sentence is true:

An increase in the share of value of auxiliary services or key services purchased from other enterprises in the operating costs is not correlated in a statistically significant way with changes in the total factor productivity (TFP).

- 4) *With an increase in the share of the total value of services purchased from enterprises located abroad in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of total services purchased from enterprises located in the country.*

The results of the estimation of panel data models carried out for panel B, in which the share of the value of services purchased from other enterprises located in the country and abroad in operating costs was introduced as the key independent variables, suggest that the relationship between these variables and the TFP is statistically insignificant at the 5% significance level.

Therefore, the hypothesis was not confirmed. The obtained results show that:

Both an increase in the share of the value of services purchased from enterprises located abroad and an increase in the share of the value of services purchased from enterprises located in the country in operating costs are not statistically, significantly related to changes in the total factor productivity (TFP).

- 5) *With an increase in the share of the value of purchased business services in operating costs, the total factor productivity (TFP) increases more than in the case of an increase in the share of the value of purchased external services in total.*

The results of estimates for panel data model show a positive correlation between the share of the value of purchased business services in operating costs and the TFP. Along with the increase in the share of the value of these services in operating costs by 1 p.p. the TFP increases on average by about 0.2%, *ceteris paribus*.

The original hypothesis is therefore rejected, and it is true that:

With an increase in the share of the value of purchased business services, the total factor productivity (TFP) increases on average, while an increase in the share of external services in total in operating costs is generally associated with a decrease in TFP.

Taking into account the results of verification of the specific research hypotheses formulated in this doctoral dissertation, the main research hypothesis, which reads as follows, is rejected:

Outsourcing of services contributes to an increase in the effectiveness of the functioning of enterprises up to a varying degree, depending on the size of these enterprises and the type of services purchased.

However, the obtained results suggest:

Outsourcing of services may contribute to an increase in the effectiveness of the functioning of enterprises, but to a limited and varied degree depending on the size of these enterprises. A positive relationship between the productivity of enterprises and the outsourcing of services in general occurs only after exceeding a certain threshold value of the share of purchased services in the operating costs. However, it is generally negative. Only the relationship between the outsourcing of business services and the TFP is positive across the whole domain of function.

Contribution to literature

The research topic undertaken in this doctoral dissertation is the first attempt to quantify the relationship between the phenomenon of services outsourcing and the productivity of enterprises in Poland. The results obtained within the conducted research work provides new knowledge about the direction and strength of the relationship between the studied phenomena in the Polish economy.

The research carried out as part of the doctoral dissertation makes a significant contribution to the development of the methodology for measuring the relations between various economic phenomena, including in particular the outsourcing of services, and the effectiveness of enterprises in Poland. Although the solution related to the use of the total factor productivity (TFP) as a variable reflecting the productivity of enterprises, as well as the methods selected to estimate the TFP, are widely used in research practice, the procedures that were employed to quantify the relations between the purchase of services from other enterprises and the TFP, constitute a new approach in observing the Polish economy. In the research work, well-known, advanced econometric tools were used, which, using a unique set of data on the demand for services in Poland, made it possible to determine the nature of the relationship between the purchase of services and the TFP in Poland. Both panel data models with fixed effects, as well as generalized additive models (GAM), which enables identification of the shape of nonlinear relationships and their graphical presentation, were used. An unprecedented solution was also the introduction to the panel data models such a wide range of variables which reflect the phenomenon of outsourcing of services in general, as well as its various aspects.

The solution of the research problem which is the subject of this doctoral dissertation, apart from its cognitive character, may also have a practical application in the surveys of official statistics. Conducting research work as part of the methodological works of Polish official statistics contributes to the development of methodology dedicated to the phenomenon of outsourcing of services. On the other hand, the gained experiences made it possible to identify information gaps and to specify the scope of information that should be collected within the cyclical *Demand for services* survey.

Final remarks

Although within this doctoral dissertation the research hypotheses have been verified, the experiences gained during its implementation indicate the directions of further works which could be undertaken in the analysed research area.

First of all, attention should be paid to the explanatory variables used in the TFP estimation. Regarding a variable reflecting labor inputs it is recommended to introduce to the econometric model the number of worked hours rather than the average number of employed persons. This variable more precisely defines the amount of labour inputs. Nevertheless, the use of worked hours in the research work was not possible due to the lack of access to unit data.

Another challenge is to provide access to the value data on the size of the outsourcing of various categories of services. In this research, qualitative information was used to determine the value of auxiliary or key services purchased from other enterprises, or the value of services purchased at home or abroad. It could have had an impact on the results obtained under the models.

Moreover, the findings obtained as part of this doctoral dissertation, as well as the experiences related to the measurement of the relationship between the outsourcing of services and the productivity of enterprises, described in the related literature, indicate the need for further, more comprehensive analyses. They should comprise the various sub-populations of enterprises with specific characteristics that may affect the scale of the outsourcing phenomenon or the productivity of enterprises.

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Annex Research and academic activity

Education

Period	February 2014 – February 2018
Name	Warsaw School of Economics
Unit	Collegium of Economic Analyses
Type of studies	Non-stationary Doctoral Studies in cooperation with the Statistics Poland
Period	October 1997 – June 2002
Name	University of Łódź
Unit	Faculty of Economics and Sociology, Field: International Relations in Economics and Politics
Type of studies	stationary
Specialisation	International Finance
Tytuł pracy magisterskiej	The participation of Poland in the organisations regulating the international trade
Uzyskany tytuł naukowy	M.A.

Publikacje

Period	2017
Title	<i>Methods for compiling the services volume index based on example of the office administrative and support activities</i>
Journal	The Polish Statistician No 8/2017, p.19-40
Period	2014
Title	<i>Business services statistics – current state and challenges</i>
Journal	The Polish Statistician No 6/2014, p. 47-64
Period	2012
Title	<i>Servises statistics in the works of the Voorburg Group Voorburg</i>
Journal	The Polish Statistician No 2/2012, p. 15-22 (co-authorship with Ewa Adach-Stankiewicz - 50%)
Period	2009
Title	<i>Methodology for measuring the production of services sector</i>
Journal	Institute of Market, Consumption and Situation Research, Internal market – special number, May 2009, p. 188-198 (co-authorship with Renata Rechnio - 50%)

Conferences

- *Methodology of Statistical Research (MED2019)*, organizer: Statistics Poland in cooperation with the Polish Statistical Association, Warsaw, 3 – 5 July, 2019;
- *From Population Census in the Polish-Lithuanian Commonwealth to the National Census of Population and Housing 2021*, organizer: the Regional Office in Łódź in cooperation with the Statistics Poland, the Polish Statistical Association and the Committee Of Statistics and Econometrics of the Polish Academy of Science, Łódź, 18-19 March, 2019;
- *2nd Congress of Polish Statistics*, organizer: the Statistics Poland and the Polish Statistical Association, Warsaw, 10– 12 July, 2018;
- *Depopulation and a new paradigma of cities and regions' development*, organizer: University of Łódź and the Polish Academy of Science, Łódź - Spata, 20-22 April, 2017;
- *Modelling and Forecasting the National Economy*, organizer: University of Gdańsk, Sopot, 29-31 May, 2017;
- *Warsaw International Economic Meeting*, organizer: the University of Warsaw, Faculty of Economic Sciences in cooperation with the CenEA, Warsaw, 4-6 July, 2017;
- *Statistical identification of the relationships in the social-economic area*, organizer: the Statistics Poland and the Regional Office in Poznań in cooperation with the University of Economics in Poznań, Poznań, 14-15 June, 2016;
- *Statistics - Knowledge – Development*, organizer: the Statistics Poland, the Regional Office in Łódź, the Polish Statistical Association and the University of Łódź, Łódź, 17-18 October, 2013, presentation: *Business services statistics – current state and challenges*;

Educational activity 2014-2018

- exercises in *Statistics* at the bachelor studies;
- lecture *National Census of Population and Dwellings 2011* within the subject *Social statistics* at the bachelor studies;

Other research works and activities:

- Conducting the methodological work 3.251 *Impact of outsourcing of services on the productivity of enterprises* (work realised in period 2019-2020 as a part of *Polish Official Statistics*);
- Participating as a leading expert in the research works:
 - *Export of goods and services at the subregion level (NTS3)* realised within the project *Statistics for the coherency policy. Support for system of monitoring the coherency policy in the financial perspective 2014-2020 and programming and monitoring the coherency policies after 2020 (2017-2018)*;
 - *Foreign trade by voivodships (NTS2)* realised within the project *Statistics for the coherency policy. Support for system of monitoring the coherency policy w the financial perspective 2007-2013 and programming and monitoring the coherency policies 2014-2020 (2014-2015)*;
- Coordination of the projects realised with co-financing of the European Commission under the grant agreements:
 - *International trade in services. Area A. International trade in services by enterprises' characteristics (STEC). Area B. International trade in services by modes of supply. Area C. International trade in services by CPA - period -XI.2019 - V.2022*;
 - *Commercial Real Estate Indicators – period - I.2019 - III.2021*;

- *International trade in services. Area A. International trade in services by enterprises' characteristics (STEC). Area B.1. International trade in services by modes of supply – pilot study; Area B.3. International trade in services by modes of supply – modification of the model compiled by Eurostat - period –X 2018 - VI.2019;*
- *Development of methodological and statistical basis for new index of services production (ISP) – period – 2014 - 2015;*
- Participating in the projects realised with co-financing of the European Commission under the grant agreements:
 - *Real estate indicators. Development of methodology for compiling the house prices indices (HPI) at lower levels of aggregation – period – 2018-2019;*
 - *Real estate market statistics. Residential real estate sales indices – period – 2014-2016;*
 - *Integrated global accounts and global production – period – 2016-2018;*
 - *Demand for services – pilot study - period – 2004-2005;*
 - *Business services – pilot study (2 editions) – period - 2004-2007;*
- Conducting the methodological work *Evaluation of indices for production of services sector* (works performed in period 2015- 2018 as a part of *Polish Official Statistics*);
- Active participation in the works of Voorburg Group on services statistics (since 2006);
- Participation the meetings of working groups, task forces of Eurostat and OECD dedicated to the services statistics, real estate market or censuses;

A. Chetwiska-Bachuna